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Paramphistomes (Trematoda: Amphistomida) of domestic ruminants in Kashmir, India

By

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ABSTRACT. Eleven species of paramphistomes are described from domestic ruminants of Kashmir, namely, Paramphistomum epiclitum Fischoeder, 1904; P. gracile Fischoeder, 1901; Calicophoron calicophorum (Fischoeder, 1901) Nasmark, 1937; C. papillosum (Stiles et Goldberger, 1910); Orthocoelium dicranocoelium (Fischoeder, 1901) Yamaguti, 1971; O. dinniki Eduardo, 1985; O. gigantopharynx (Schad, Kuntz, Anteson et Webster, 1964) Eduardo, 1985; O. indonesiense Eduardo, 1980; Olveria indica Thapar et Sinha, 1945; Gastrothylax crumenifer (Creplin, 1847) and G. compressus Brandes, 1898. Of these, nine species are new to Kashmir, and in the present study paramphistomes from domestic bovines are included for the first time. The most common paramphistome was G. compressus and the least common one Olveria indica. G. orientalis Bambroo, 1970 is synonymised with G. compressus.

KEY WORDS: Paramphistomes, (Trematoda: Amphistomida), Kashmir, new reports, goat, sheep, bovines.

Paramphistomes cause a lot of damage to live-stock in a number of different ways and also inflict mortality to them (ERSHOV, 1956; LAPAGE, 1967 and KURTPINAR and LATIF, 1970). Therefore, the study of paramphistomes parasitizing domestic ruminants is important, particularly in view of the fact that such a study has not received adequate attention in Kashmir. The references available on the subject pertaining to domestic ruminants of Kashmir are only a few which give random reports of some species of paramphistomes, viz. BAMBROO (1970) reports Gastrothylax glandiformis Yamaguti, 1939 and describes a new species G. orientalis Bambroo, 1970; BALI (1971) reported Calicophoron calicophorum (Fischoeder, 1901) Näsmark, 1937; BALI and FOTEDAR (1972a, 1972b and 1973) reported Paramphistomum skrjabini Popova, 1937, Ceylonocotyle scoliocoelium (Fischoeder, 1904) Näsmark, 1937 and described a new species Olveria thapari Bali and Fotedar, 1973, respectively; BALI (1976) in his check-list of paramphistomes from Jammu and Kashmir mentioned three more species, namely, Gastrothylax crumenifer (Creplin, 1847), Paramphistomum cervi (Zeder, 1790) and Cotylophoron cotylophorum (Fischoeder, 1901) in addition to the ones already mentioned above; DUTT (1978), while describing Gastrothylax indicus Dutt, 1978 mentions that the material was from sheep from Kashmir also in addition to other places in India; RAINA and KHAN (1982) have discussed the prevalence of paramphistomes of domestic ruminants in Kashmir without identifying up to the species level and in 1983 reported excysted gastrothylacid metacercariae.

All these above-mentioned paramphistomes have been reported from sheep only and no attempt has so far been made to study the paramphistomes of bovines in Kashmir. Moreover, the earlier studies have mainly been made from whole-mounts and the muscular organs have either not been taken into consideration or have not been described. Thus as a first step, an attempt has been made to make a comprehensive survey of paramphistomes of domestic ru-

minants in Kashmir on the basis of histomorphological details of muscular organs. The present paper also includes for the first time the paramphistomes of bovines of Kashmir.

MATERIAL AND METHOD

Paramphistomes were directly picked up from the rumina of domestic ruminants and fixed in 70 % ethanol. They were given a rinse in 70 % ethanol to remove any attached debris and preserved in fresh 70 % ethanol. The collections from sheep and goats were made from different slaughter houses located in Srinagar, Pulwama, Anantnagh, Verinagh, Tral and Pattan. The collections from bovines were made with a great difficulty because regular slaughtering of bovines is not a common practice in Kashmir. They were collected from some cattle and buffaloes, particularly in the towns of Tral, Pattan, Baramula and Sopore. In all thirty-five samples were procured during January to the end of October, 1986 (12 samples from sheep; 12 from cattle; seven from buffaloes and four from goat). Histomorphological preparations were made by the usual methods and the work was finally completed in the Department of Zoology, Janus Pannonius University of Pécs during the winter of 1986-87, when the first author was on an official visit to Hungary.

RESULTS AND DISCUSSION

Eleven different species of paramphistomes, belonging to five different genera were identified in the present samples. Of these, nine are new to Kashmir. As earlier authors have not given the histomorphological details of the muscular organs, we present the histomorphological characters of all including those which are already known from Kashmir, as follows:

Paramphistomum epiclitum Fischoeder, 1904 (Fig. 1)

This species is being reported for the first time from Kashmir and in all sixteen samples contained this species (cattle=9, sheep=3, goat=2 and buffalo=2). In the present collection it was observed to be the third most common paramhphistome in Kashmir.

This species is characterised by a Calicophoron type of pharynx (Sensu DINNIK, 1964: = Paramphistomum type of NÄSMARK, 1937). Middle circular layer of muscles, in addition to the outer and inner ones was noted in the median sagittal sections of the pharynx. A few small papillae are present in the anterior region of the pharynx. The acetabulum is of a Paramphistomum type (Sensu NÄSMARK, 1937, EDUARDO, 1982) and the various muscle units noted in the present study are: D. C. E. 1=20-35; D. E. C. 2 = 20-40; the former being larger than the latter; D. I. C. = 45-72; V. E. C. = 14-30; V. I. C. = 65-70; M. E. C. = 13-16. The genital opening is of the Epiclitum type (Fig. 1), without a true genital sucker. Pars prostatica is very well marked and wide, surrounded by a large number of prostate gland cells in rows.

Legend to figures

Figs 1-18. Median sagittal sections of amphistomids
Fig. 1. Paramphistomum epiclitum (genital opening)
Figs 2-3. Calicophoron calicphorum (2= dorsal half of acetabulum, 3= genital opening)
Fig. 4. C. papillosum (genital opening).
Figs 5-6. Orthocoelium dicranocoelium (5= pharynx, 6= genital opening)
Figs 7-9. O. dinniki (7= dorsal half of acetabulum, 8= ventral half of acetabulum, 9= genital opening)
Figs 10-11. O. gigantopharynx (10= pharynx, 11= genital opening)
Figs 12-13. O. indonesiense (12= ventral half of acetabulum, 13= genital opening)
Figs 14-15. Olveria indica (14= genital opening, 15= dorsal half of acetabulum)
Figs 16-18. Gastrothylax compressus (16= pharynx, 17= dorsal half of acetabulum, 18= genital opening)

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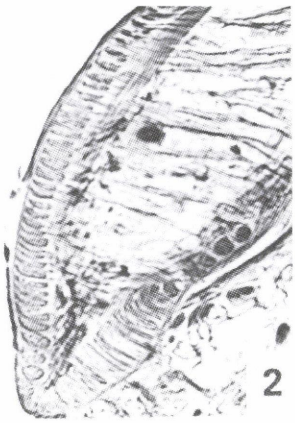
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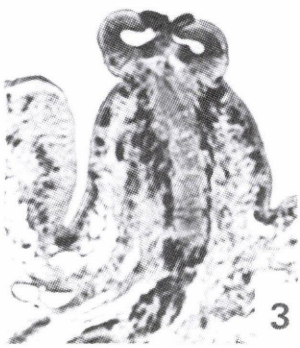
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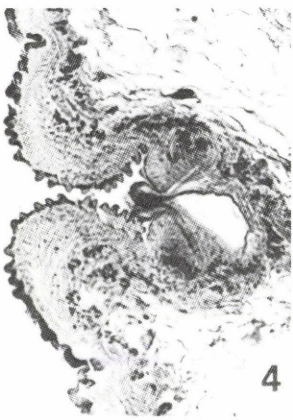
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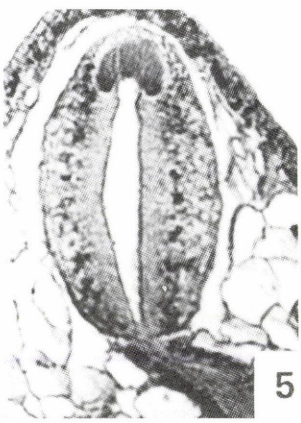
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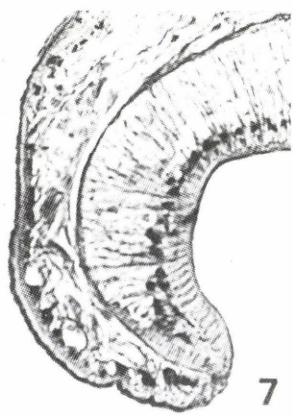
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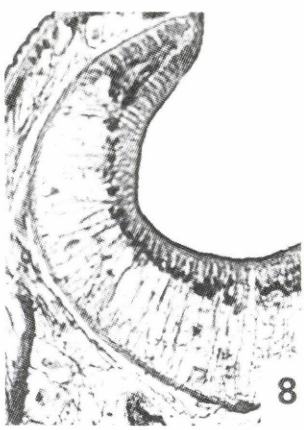
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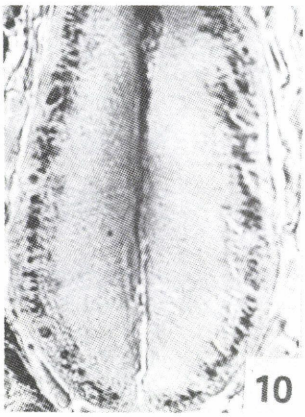
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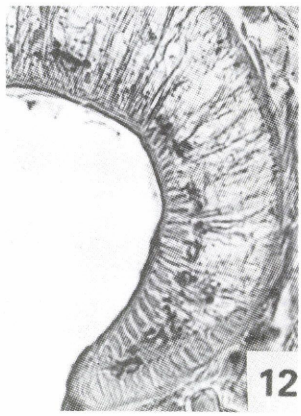
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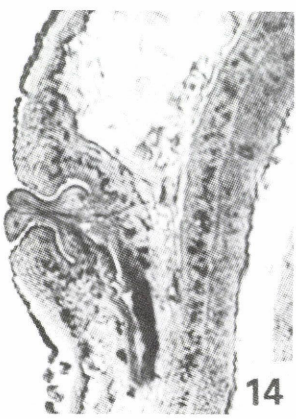
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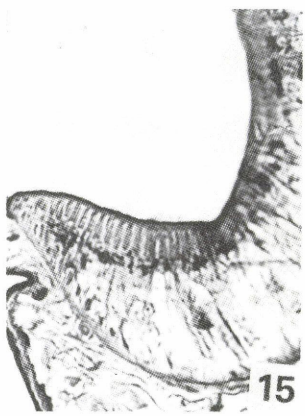
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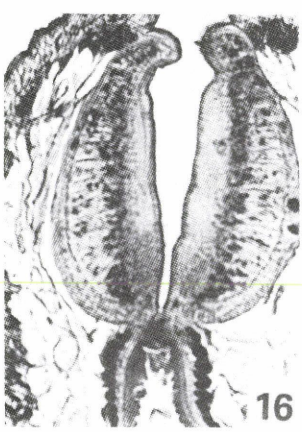
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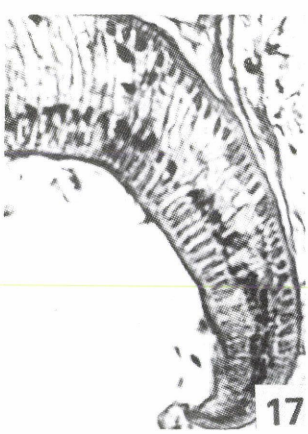
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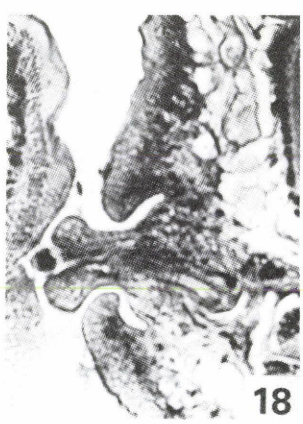
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P. epiclitum was originally described by FISCHOEDER (1904) from Saigon and was later reported from Pakistan by GUPTA (1963) and from India by GUPTA and NAKHASI (1977). SEY (1979) treats Cotylophoron indicum Stiles et Goldberger, 1910; Paramphistomum thapari Price et McIntosh, 1953 and Srivastavaia indica Singh, 1970 as its synonyms which is followed here also.

Paramphistomum gracile Fischoeder, 1901

P. gracile was noted in 21 samples (cattle= 8; sheep= 7; goat= 3; and buffalo= 3) and is the second most common paramphistome in the present collection. Its pharynx is of the Calicophoron type and all the three layers of the circular muscles were noted to be present, the middle one, however, is very weakly developed and the inner one consists of a single row of fibres. Pharyngeal papillae were seen in the anterior region of the pharynx. The inner longitudinal muscles were observed to be well developed whereas the outer longitudinal muscles form a very thin layer. The acetabulum is similar to P. epiclitum in being of the Paramphistomum type, however, the different muscle counts observed are: D.E.C.1= 25-35; D.E.C. 2= 20-40; D.I.C.= 45-65; V.E.C.= 20-48; V.I.C.= 66-74 and M.E.C.= 15-20. The genital opening is of the Gracile type, there being no circular and radial muscle fibres.

P. gracile has been found in the domestic ruminants of Kashmir for the first time in the present investigation, whereas the only other two species reported so far from Kashmir by BALI and FOTEDAR (1972a) and BALI (1976) are P. skrjabini Popova, 1937 and P. cervi (Zeder, 1790), respectively. Unfortunately, their description of P. skrjabini is without any reference to the histomorphology of the muscular organs and this species has been synonymised with Calicophoron calicophorum by EDUARDO (1983). Regarding P. cervi, no description at all has been furnished by BALI (1976). In view of this it is not certain whether the reports of these two species from Kashmir are correct and therefore need further investigation. It may not be cut of place to mention that SEY (1979) also doubts the earlier reports of P. cervi from India and in his opinion based on a survey, this species "is not found in India". In view of these facts the paramphistomes of the Indian region need a thorough survey to bring out a complete and correct picture of the various forms known there.

Calicophoron calicophorum (Fischoeder, 1901) Näsmark, 1937 (Figs 2 and 3)

C. calicophorum, in its prevalence among the domestic ruminants of Kashmir has a fourth place as per the present investigation (found in 7 cattle, 5 sheep, and 2 goat samples). This species has all the muscular organs and genital opening of the Calicophoron type. The middle layer of the circular muscles of the pharynx was seen to be absent in the present study. The acetabular muscle counts were observed to be as: D.E.C.= 12-25; D.I.C.= 40-65; V.E.C.= 10-20; V.I.C.= 55-64; M.E.C.= 14-17. Sometimes a few muscle units may lie outside the group of dorsal exterior circular fibres giving an appearance of D.E.C.2 series but in reality there is no such series in this form. The genital opening is characterised by the presence of a retractile genital pillar (Fig. 3).

BALI (1971) gives a gross morphological description of this species and later in 1976 mentions it in his check-list of paramphistomes without giving any reference to the muscles of various organs. It may not be out of place to mention that without studying the musculature of various organs, it is not possible to identify the species. He has recorded this species in sheep and in the present investigation it is also being reported from cattle and goat.

Calicophoron papillosum (Stiles et Goldberger, 1910) (Fig. 4)

C. papillosum is similar to C. calicophorum in having acetabulum and pharynx of the Calicophoron type but the terminal genitals in C. papillosum are of the papillogenitalis type (Sensu EDUARDO, 1980a) (Fig. 4)

The acetabular circular muscle counts noted in the present study are: D.E.C.= 18-25; D.I.C.= 30-40; V.E.C.= 11-15; V.I.C.= 33-40; and M.E.C.= 7-12 scattered units.

The papillogenitalis type of genital opening is characterised by the presence of small papillae lining the surface of the genital fold. Overall the terminal genitalia are comparatively smaller and the radial muscles are clearly seen.

This species was found in two samples only, one each from cow and buffalo, and is being reported for the first time from Kashmir and Indian region.

Orthocoelium dicranocoelium (Fischoeder, 1901) Yamaguti, 1971 (Figs 5 and 6)

O. dicranocoelium was observed in three samples, two from buffalo and one from sheep. It has an acetabulum of the Streptocoelium type (Sensu NÄSMARK, 1937) with D.E.C.= 12-17; D.I.C.= 20-25; V.E.C.= 15-18; V.I.C.= 22-26 and M.E.C.= 8-12. On the whole the acetabulum of this species was observed to be clumsy and comparatively smaller, with interior series always more in number and with larger-sized units.

The pharynx is of the Dicranocoelium type with a very well developed horse-shoe shaped lip shincter (Fig. 5). The middle circular units are not present and the basal circular units are only a few and in a single row. Oesophagus is long and thick-walled (Fig. 5) and forms a circular to oval bulb at its posterior end.

Testes are tandem and the opening of Laurer's canal is located anterior to the excretory pore on the dorsal side. The genital terminalia as per NÄSMARK (1937) were observed to be of the Gracile type (Fig. 6). The present finding is the first report of O. dicranocoelium from Kashmir.

Orthocoelium dinniki Eduardo, 1985 (Figs 7-9)

O. dinniki was encountered in three samples only, one each from cow, buffalo and goat. It has a Streptocoelium type of acetabulum (Figs 7 and 8) and the various muscle counts observed are: D.E.C.= 16-20; D.I.C.= 30-36; V.E.C.= 17-20; V.I.C.= 38-44 and M.E.C.= 6-9. The acetabulum of this species is comparatively larger and more massive than C. dicranocoelium. In this species it was noted that the internal and external series of the circular muscles are equally massive in size but differ constantly in number.

The pharynx is of the Calicophoron type (Sensu DINNIK, 1964) with basal circular units in one row. The outer circular layer was seen to be very well developed, the inner one moderately so and the middle one is reduced. The pharynx bears papillae at its oral end. The oesophagus is thick-walled with a posterior sphincter.

Testes are moderately large and tandem. The genital opening is of the papillogenitalis type (Sensu EDUARDO, 1980a) in a median sagittal section with distinct integumentary papillae on the external surface (Fig. 9). O. dinniki is a new report from Kashmir and the Indian region.

Orthocoelium gigantopharynx (Schad, Kuntz, Anteson et Webster, 1964) Eduardo, 1985 (Figs 10 and 11)

O. gigantopharynx was noted only in one sample i.e. from buffalo. This species has a pharynx of the gigantopharynx type (Sensu EDUARDO, 1982), with a comparatively very large pharynx (Fig. 10) bearing conical long papillae in the anterior region. Posterior oesophageal sphincter is present.

The acetabulum is of the Streptocoelium type, the circular muscle units observed being D.E.C.= 30-35; D.I.C.= 36-50; V.E.C.= 15-25; V.I.C.= 30-50; and M.E.C.= 15-18.

The two testes are median and tandem. The genital opening is of the microbothrium type with a well developed genital sphincter and genital papilla (Fig. 11). O. gigantopharynx is a new report for Kashmir.

Orthocoelium indonesiense Eduardo, 1980 (Figs 12 and 13)

O. indonesiense was observed in three samples, one each from cow, buffalo and goat. The distinguishing features of this species are the presence of a Calicophoron type of pharynx (Sensu DINNIK, 1964 and EDUARDO, 1985 = Paramphistomum type of NÄSMARK, 1937 and EDUARDO, 1980b), papillogenitalis type of genital terminalia (Fig. 13) and the acetabulum has a flat bottom at right angles to the walls and each of the circular muscle series is in a single group with number of units less than the Gastrothylax type. Such type has been designated as Carmyerius type by SEY (1983), therefore, EDUARDO's (1980b) description of a Gastrothylax type of acetabulum in O. indonesiense should in reality be treated as Carmyerius type because the number of muscle units approaches the Carmyerius type (Sensu SEY, 1983) rather than the Gastrothylax type. The muscle counts are: D.E.C.= 18-20; V.E.C.= 18-20; D.I.C.= 20-25; V.I.C.= 18-24 and M.E.C.= 8-10. The pharynx in the present specimens does not show any middle circular layer and the basal circular layer is single or double.

The oesophagus is moderately long and with thick muscular walls. Posterior bulbous expansion or shincter is absent.

Testes are median, lobed and tandem. O. indonesiense is being repoted for the first time from Kashmir and India.

Olveria indica Thapar et Sinha, 1945 (Figs 14 and 15)

The least common paramphistome observed in the present collection was O. indica from the rumen of a buffalo. It has an Olveria type (new type) of pharynx, characterised by a very short but wide pharynx with two fused pharyngeal pouches. Lip, anterior and posterior sphincters are absent. The musculature of the pharynx is weakly developed in comparison to other types. The internal circular muscles form a single row and the middle circular layer is weakly developed and not visible in some sections, the internal layer is reduced. The outer longitudinal layer is comparatively better developed than the internal layer. A few papillae are present in the anterior region of the pharynx. Basal circular muscles were not seen, radial fibres are very well developed. The most characteristic feature of this type is that the oesophagus is over-four to six times longer than the pharynx and is typically J-shaped. It is very wide anteriorly and narrows down slowly towards the posterior end. Its walls are very thick, almost with the same thickness as that of the pharynx. Posterior pharyngeal sphincter is absent.

The acetabulum is of the Streptocoelium type (Fig. 15) with various circular muscle units as: D.E.C. = 15-20; D.I.C. = 30-35; V.E.C. = 10-15; V.I.C. = 30-35 and M.E.C. = 8-12.

Testes are tandem or slightly oblique and the genital pore is located in the anterior third of the oesophageal level. Genital terminalia are of the Olveria type (new type) characterised by the absence of a ventral fold, ventral sphincter and ventral atrium; presence of a well developed and terminally broad genital papilla (Fig. 14), moderately developed genital fold; well developed genital sphincter and continuous almost compact sphincter papillae extending nearly up to the genital sphincter and a short distance into the genital papilla. The external surface of the genital fold bears integumentary papillae. This present form resembles the Streptocoelium type but the genital papilla is very broad terminally and the genital fold bears a few integumentary papillae. From the papillogenitalis type the present type can be differentiated by a strong genital sphincter and almost continuous sphincter papillae. The integumentary papillae are not as well developed and numerous as in the papillogenitalis type.

O. indica was originally proposed by THAPAR and SINHA (1945) but they did not describe its histomorphological details. They based their description mostly on the gross morphological characters. They report the pharynx to be absent and instead call it oral sucker and oral pouches but now it is a universally accepted fact that the anterior muscular organ in the paramphistomes represents pharynx. Hence we refer to the anterior muscular organ as pharynx and its pouches as pharyngeal pouches.

Two more species, namely, O. bosi Tandon, 1951 and O. thapari Bali et Fotedar, 1973 have been reported from Lucknow and Kashmir, respectively. Both these species seem to have been created on flimsy grounds. No histomorphological details of the muscular organs have been studied or given by their respective authors. In the opinion of the present authors, these two species in question seem to be only synonyms of O. indica but further study of the type material and histological investigations are needed to confirm the above statement.

Gastrothylax crumenifer (Creplin, 1847)

G. crumenifer has a Gastrothylax type of acetabulum (Sensu SEY, 1983) and pharynx (Sensu NÄSMARK, 1937) and Gracile type of genital terminalia. The number of acetabular circular muscles is very large.

This species was reported from sheep in Kashmir by BALI (1976) but in the present investigation it was collected from all the domestic ruminants studied. It is comparatively less common than G. compressus.

Gastrothylax compressus Brandes, 1898 (Figs 16-18)

This species is the most common in our collection and was present in 32 samples. It is characterised by the presence of a Gastrothylax type of pharynx (Fig. 16) and a Carmyerius

type (Fig. 17) of acetabulum (Sensu SEY, 1983) with circular units far less than the Gastrothylax type, being in the present specimens as: D.E.C.= 45-65; D.I.C.= 35-46; V.E.C.= 45-68; and V.I.C.= 30-46. The genital opening is of a Gracile type (Fig. 18).

So far four species of Gastrothylax, namely, G. crumenifer (Creplin,1847), G. orientalis Bambroo, 1970, G. glandiformis Yamaguti, 1939 and G. indicus Dutt, 1978 have been reported from Kashmir. G. glandiformis and G. indicus have been synonymised by SEY (1983) with G. compressus which is also followed here. G. orientalis has been created on minor individual variations. It resembles G. compressus in all its features and the number of circular muscle units also approaches that of the acetabulum of G. compressus. Therefore, the authors have no hesitaion in treating G. orientalis as a synonym of G. compressus.

In the end it is remarked that there is still a lot of confusion regarding the correct identification of many other paramphistomes from the Indian region and a through investigation is needed to bring out the correct picture.

ZOOGEOGRAPHICAL NOTE ON PARAMPHISTOMES OF KASHMIR

The Kashmir valley (lat. 33°-35°N: longt. 73°-78°E: area 15120 sq. km) is of an irregular oval shape situated north of the Pirpanchal Himalayas above the altitude of 1700 m. The climate is temperate-cum-mediterranean with an average mean maximum temperature of 6.6°C during winter and an average mean maximum temperature of 28.9°C during summer (J and K. D.O.S, 1982)*. A natural consequence of all these factors is the prevalence of a number of grass-lands, meadows and pastures in the valley, which according to a live-stock census (J and K, Live-stock Census, 1982)** support roughly a population of 79 140 goats, 889 880 sheep and 1 103 703 bovines. Most of these domestic ruminants are sent to low altitude grasslands and meadows for grazing in spring and later in summer they go to high altitude pastures and return before the advent of winter. It is in these grazing areas where the intermediate hosts-snails abound, and where the domestic ruminants are prone to get the infection of paramphistomes. The buffaloes, however, are brought from the Jammu region of J and K State during spring and summer for grazing and are then taken back to the warmer areas of the State. Therefore, it needs further investigation whether their amphistome infection is exclusively from local sources or from parts other than Kashmir or both. However, due to the presence of similar infection in most of the other domestic ruminants, it seems that the infection may be mostly local.

The species composition of paramphistomes presently investigated seems to be mostly oriental, for example, Paramphistomum epiclitum, P. gracile, Gastrothylax crumenifer, G. compressus and Calicophoron papillosum, which according to SEY and ESLAMI (1982) are oriental. Orthocoelium dicranocoelium and O. gigantopharynx are Indo-Malayan. O. indonesiense, described so far from Indonesia only is being reported from Kashmir. O. dinniki has been reported from the Philippines, China and Japan and the present finding shows that its range of distribution can be up to Kashmir or it is equally possible that it was introduced because lot of domestic animals are imported into the valley of Kashmir from many parts of India and abroad. Life cycle studies are needed to find out the endemic areas of infection in the valley.

Olveria indica seems to be an exclusively Indian form and has not been recorded in any other country until now. Calicophoron calicophorum, however, has a wide distribution in Asia, Australia (probably introduced), Africa and some parts of America.

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REFERENCES

BALI, H.S. (1971): On the occurrence of Calicophoron calicophorum (Fischoeder, 1901) Nasmark, 1937 in sheep of Jammu and Kashmir State. - Indian vet. J., 49: 432-433.

BALI, H.S. (1976): A survey of helminth parasites of sheep (Ovis aries) in Jammu and Kashmir. - J. Anim. Hlth Prod., 4: 25-32.

BALI, H.S. and FOTEDAR, D.N. (1972a): Study on a new trematode belonging to the genus Paramphistomum Fischoeder, 1901, from Ovis aries in Jammu and Kashmir State. - Indian J. anim. Sci., 42: 231.

BALI, H.S. and FOTEDAR, D.N. (1972b): On the morphology of a paramphistome in sheep, Ceylonocotyle scoliocoelium from Jammu and Kashmir. - J. Res. Punjab Agric. Univ., 9: 199-200.

BALI, H.S. and FOTEDAR, D.N. (1973): On a new amphistome Olveria thapari n. sp. from the rumen of cross-bred sheep from Kashmir. - Indian J. Helminth., 24: 36-39.

BAMBROO, N. (1970): On two species of Gastrothylax Poirier, 1883 from sheep in Kashmir. - Kashmir, Sci., 7: 147-155.

BRANDES, G.Z. (1898): Die Gattung Gastrothylax. - Abh. naturforsch. Ges. Halle, 21: 195-225.

DINNIK, J.A. (1964): Paramphistomum sukumum sp. nov. and other stomach flukes from cattle in the Skumaland area of the Lake Region, Tanganyika. - Parasitology, 54: 201-209.

DUTT, S.C. (1978): Paramphistomes of bovines with description of Gastrothylax indicus n. sp. - Indian J. Parasit., 2: 39-41.

EDUARDO, S.L. (1980a): Bilatorchis papillogenitalis n. gen. n. sp. (Paramphistomidae: Orthocoelinae), a parasite of the red lechwe (Kobus leche Gray, 1850) from Zambia. - System. Parasit., 1: 141-149.

EDUARDO, S.L. (1980b): Orthocoelium indonesiense, a new species of amphistome from ruminants in Indonesia. - System. Parasit., 1: 203-210.

EDUARDO, S.L. (1982): The taxonomy of the family Paramphistomidae Fischoeder, 1901 with special reference to the morphology of species occurring in ruminants. I. General considerations. - System. Parasit., 4: 7-57.

EDUARDO, S.L. (1983): The taxonomy of the family Paramphistomidae Fischoeder, 1901 with special reference to the morphology of species occurring in ruminants. III. Revision of the genus Calicophoron Nasmark, 1937. - System. Parasit., 5: 25-79.

EDUARDO, S.L. (1985): The taxonomy of the family Paramphistomidae Fischoeder, 1901 with special reference to the morphology of species occurring in ruminants. VI. Revision of the genus Orthocoelium (Stiles and Goldberger, 1910) Price and McIntosh, 1953. - System. Parasit., 7: 125-158.

ERSHOV, V.S. (1956): Parasitology and parasitic diseases of live-stock. - State Publishing House for Agricultural Literature, Moscow. pp. 478.

FISCHOEDER, F. (1901): Die Paramphistomiden der Säugetiere. - Zool. Anz., 24: 367-375.

FISCHOEDER, F. (1904): Weitere Mitteilungen über Paramphistomiden der Säugetiere. - Zblt. Bakt. Par., 35: 598-601.

GUPTA, N.K. (1963): On Paramphistomum epiclitum Fischoeder, 1904, a parasite of the farm animals in the Punjab. - Res. Bull. Punjab Univ., 14: 307-311.

GUPTA, N.K. and NAKHASI, U. (1977): On some amphistomid parasites from India (Part I). - Revta iber. Parasit., 37: 205-225.

KURTPINAR, H. and LATIF, B.H. (1970): Paramphistomiasis of cattle and buffaloes in Iraq. - Vet. Rec., 87: 668.

LAPAGE, G. (1967): Veterinary Parasitology. - Oliver and Boyd, Edinburgh and London, pp. 964.

NASMARK, K.E. (1937): A revision of the trematode family Paramphistomidae. - Zool. Bidr. Upps., 16: 301-565.

RAINA, M.K. and KHAN, M.D. (1982): Prevalence of amphistomes in ruminants in Kashmir. - Kashmir Univ. Res. J., 2: 17-21.

RAINA, M.K. and KHAN, M.D. (1983): Excysted amphistome metacercariae. - Indian J. Parasit., 7: 115-116.
SCHAD, G.A., KUNTZ, R.E., ANTESON, R.K. and WEBSTER, G.F. (1964): Amphistomes (Trematoda) from domestic ruminants in North Borneo (Malaysia). - Can. J. Zool., 42: 1037-1040.
SEY, O. (1979): Examination of the validity and systematic position of some Paramphistomids of Indian ruminants. - Parasit. hung., 12: 31-36.
SEY, O. (1983): Revision of the family Gastrothylacidae Stiles et Goldberger, 1910 (Trematoda: Paramphistomata). - Acta zool. hung., 29: 223-252.
SEY, O. and ESLAMI, A. (1982): Review of amphistomes (Trematoda: Paramphistomata) of Iranian domestic ruminants. - Parasit. hung., 14: 61-65.
STILES, C.W. and GOLDBERGER, J. (1910): A study of the anatomy of Watsonius (n.g.) watsoni of man and of nineteen allied species of mammalian trematode worms of the superfamily Paramphistomoidea. - Bull. hyg. Lab. Wash., 60: 1-259.
TANDON, R.S. (1951): On a new amphistome, Olveria bosi n. sp. from the rumen of buffalo, Bos bubalis, from Lucknow. - Indian J. Helminth., 3: 93-100.
TANDON, R.S. (1955): A redescription of Paramphistomum gotoi Fukui, 1922 an Indian record of the species. - Indian J. vet. Sci., 25: 225-233.
THAPAR, G.S. and SINHA, B.P. (1945): On the morphology of a new genus of amphistomes from the rumen of cattle in the United Provinces. - Indian J. vet. Sci., 15: 219-222.
YAMAGUTI, S. (1971): Synopsis of digenetic Trematodes of Vertebrates. 1. and 2. - Keigaku Publishing Co. Tokyo, pp. 1475.

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